PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-281302

(43)Date of publication of application : 31.10.1997

(51)Int.Cl. G02B 3/00

(21)Application number : 08-094972 (71)Applicant : NIPPON SHEET GLASS CO LTD

(22)Date of filing : 17.04.1996 (72)Inventor : KUSUDA YUKIHISA
SATO AKIMITSU
OIKAWA MASAHIRO

(54) FLAT PLATE MICROLENS ARRAY WITH REFLECTION SURFACE AND ITS PRODUCTION

(57)Abstract:
PROBLEM TO BE SOLVED: To make it possible to change an optical path length without affecting optical characteristics by forming a surface formed with lenses as a substrate front surface and the surface on the side opposite thereto as a substrate rear surface and reflecting the incident light from the substrate front surface along the optical axis in a direction exclusive of the optical axis direction by the substrate rear surface.
SOLUTION: The surface of this flat plate microlens 104 on which the microlenses 101 are formed within a transparent substrate, for example, a glass substrate 100, is formed as the substrate front surface 500 and the surface on the side opposite thereto is formed as the substrate rear surface 501. In such a case, the substrate rear surface 501 is sloped at an inclination of θ with the optical axis of the microlenses 101. The substrate rear surface 501 has a structure to reflect the incident light from the substrate front surface 500 along the optical axis toward the front surface 502 exclusive of the direction of the optical axis. The angle 6 that the refractive indices 501 forms with the optical axis of the microlenses 101 is so selected as to attain the angle satisfying the condition θ =cos-1(1/n) under which the incident light is totally reflected when the circumference of the flat plate microlens is formed of the atm. air and the refractive index of the glass substrate is defined as a real number (n) larger than 1.

CLAIMS

[Claim(s)]
[Claim 1] In the monotonous micro lens which really formed the lens which has the refractive-index inclination which changes gently-sloping towards the direction which has an optical axis in this direction of a substrate side normal, and intersects perpendicularly with the direction of an optical axis, and an optical axis in a transparence substrate The monotonous-with reflector micro lens characterized by a substrate rear face having the structure of reflecting the incident light from the substrate front face in alignment with an optical axis in the direction of [other than the direction of an optical axis] if a substrate front face and the field of the opposite side are used as a substrate rear face for the field where the lens was created.
[Claim 2] The monotonous-with reflector micro lens according to claim 1 which is the include angle which fills condition theta=COS -1 (1/n) to which said include angle theta carries out total reflection of the incident light when it is the mirror plane in which said substrate rear face has the inclination of an include angle theta to an optical axis, and the perimeter of a monotonous micro lens is made into atmospheric air and the refractive index of a substrate is made into the larger real number n than 1.
[Claim 3] The monotonous-with reflector micro lens according to claim 1 to which the metal thin film which is the mirror plane in which said substrate rear face has the inclination of an include angle theta to an optical axis, and has a high reflection factor in the field is attached.
[Claim 4] Said transparence substrate is a monotonous-with reflector micro lens according to claim 1, 2, or 3 which is glass.
[Claim 5] The manufacture approach of a monotonous micro lens including the process which really forms a gradient index lens in the front face of the transparence substrate which has an parallel flat surface according to an ionic diffusion, the process which pastes up the back up plate on said substrate front face with adhesives, the process which carry out cutting of the slot on the V type at suitable spacing to the rear face of said transparence substrate, the process which carry out cutting of the slot of U mold so that it may separate into the monotonous micro lens containing one side of said V mold groove, and the process which are desorbed from said back up plate from the separated monotonous micro lens.
[Claim 6] An optical contact equipped with the amplifier connected to the optical fiber, the monotonous micro lens according to claim 1, 2, or 3 which carries out incidence, is reflected with the substrate rear face and carries out outgoing radiation of the outgoing radiation light from said optical fiber from a substrate front face, the optical/electrical converter which was formed on the same substrate, and which receives the outgoing radiation light from said monotonous micro lens, and the optical/electrical converter by the bonding wire.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a monotonous micro lens especially the monotonous micro lens which has a reflector, and its manufacture approach. Furthermore, it is related with the optical contact which mounted such a monotonous micro lens.

[0002]
[Description of the Prior Art] A monotonous micro lens is a lens with which the microlens (micro lens) was embedded on the glass substrate front face. As shown in drawing 1 , such a monotonous micro lens forms the ion-exchange protective mask 102 which has opening 103 on a glass substrate 100, and is immersed into a solution. A micro lens 101 is formed by exchanging the ion B inside glass (for example, K, Na), and the ion A (for example, Tl) contained in an external solution from opening of a protective mask. The function as a lens is achieved because a refractive index rises because Ion A goes into the interior of glass, and the diffusion becomes semi-sphere-like. That is, a micro lens is a lens with the refractive-index inclination which changes gently-sloping towards the direction which has an optical axis in the direction of a substrate side normal, and intersects perpendicularly with the direction of an optical axis, and an optical axis.
[0003] Since the ion-exchange protective mask 102 is formed by the phot lithography method, many lenses can be made to arrange two-dimensional. This situation is shown in drawing 2 . Many micro lenses 101 are arranged on the glass substrate 100.
[0004] An example of an optical contact which used the monotonous micro lens for drawing 3 is shown. This optical contact is equipment from which two or more micro lenses condense to the photo diode 300 arranged by one dimension, and change into an electrical signal the light from two or more optical fibers 200 arranged by one dimension by the monotonous micro lens 100 arranged by one dimension. The photo diode train is established on the ceramics 400 of a rectangular parallelepiped, and pre amplifier 301 is formed on the ceramics 401 of the rectangular parallelepiped of another object.
[0005] In this optical contact, an optical fiber 200, a micro lens 101, and photo diode 300 are arranged on one optical axis. Therefore, the electrical installation of photo diode 300 and pre amplifier 301 is formed as follows. The output from photo diode 300 passes along a bonding wire 405, and is connected to the wiring 403 on ceramics 400. Wiring 403 is connected to the wiring 404 on the substrate 401 in which pre amplifier 301 appears through a bonding wire 406 again. The connection between wiring 404 and pre amplifier 301 is made by the bonding wire 407.
[0006] In the above optical contacts of a configuration, it is condensed through a lens 101 and incidence of the light which came out of the optical fiber 200 is carried out to photo diode 300. Photo diode 300 changes into an electrical signal the light which carried out incidence. An electrical signal is sent to pre amplifier 301 through a wire 405, wiring 403, a wire 406, wiring 404, and a wire 407.
[0007]
[Problem(s) to be Solved by the Invention] In the conventional optical contact shown in drawing 3 , as the wiring 403 in pre amplifier 301 from photo diode 300 showed drawing 3 , in order to bend at a right angle, an inductance component occurs. For this reason, there was a problem that a high-speed property deteriorated.
[0008] Moreover, in order to change the optical path length in a monotonous micro lens, it is necessary to change the thickness of a monotonous micro lens but, and when thickness is changed, there is a problem of affecting an optical property.
[0009] Moreover, since a monotonous micro lens is the plate of one sheet, and it is difficult to make other components contact on the occasion of mounting, it has the problem that positioning is difficult.
[0010] The purpose of this invention is to offer the monotonous micro lens which solved the above problems.
[0011] Other purposes of this invention are to offer the manufacture approach of the above-mentioned monotonous micro lens.
[0012] The purpose of further others of this invention is to offer the optical contact which used the above-mentioned monotonous micro lens.
[0013]
[Means for Solving the Problem] In the monotonous micro lens which really formed the lens with the refractive-index inclination which changes gently-sloping towards the direction which has an optical axis in this direction of a substrate side normal, and intersects perpendicularly with the direction of an optical axis, and an optical axis in the transparence substrate according to this invention If a substrate front face and the field of the opposite side are used as a substrate rear face for the field where the lens was created, it will be characterized by a substrate rear face having the structure of reflecting the incident light from the substrate front face in alignment with an optical axis in the direction of [other than the direction of an optical axis].
[0014] The include angle theta was selected so that a substrate rear face might be made into the mirror plane which has the inclination of an include angle theta to an optical axis and might carry out total reflection as reflective structure in a mirror plane.
[0015] Or the metal thin film which has a high reflection factor may be prepared in a substrate rear face as reflective structure again.
[0016] Such a monotonous micro lens is manufactured from said back up plate according to the process from which it is desorbed in the process which really forms a gradient index lens in the front face of the transparence substrate which has an parallel flat surface according to an ionic diffusion, the process which pastes up the back up plate on a substrate front face with adhesives, the process which carries out cutting of the slot on the V type to the rear face of a transparence substrate at suitable spacing, the process which carries out cutting of the slot of U mold so that it may separate into the monotonous micro lens containing one side of V mold groove, and the monotonous micro lens which be separated.
[0017] Moreover, the optical contact of this invention is equipped with the amplifier connected to the optical fiber, the monotonous micro lens which carries out incidence, is reflected with the substrate rear face and carries out outgoing radiation of the outgoing radiation light from an optical fiber from a substrate front face, the optical/electrical converter which was formed on the same substrate, and which receives the outgoing radiation light from said monotonous micro lens, and the optical/electrical converter by the bonding wire.
[0018]
[Embodiment of the Invention] The perspective view of the monotonous micro lens of this invention and a sectional view are shown in drawing 4 (a) and (b). This monotonous micro lens 104 makes this substrate rear face 501 the slant face which makes the inclination of theta to the optical axis of a micro lens 101, when the field where the micro lens 101 was created in the transparence substrate 100, for example, a glass substrate, is used as the substrate front face 500 and the field of that opposite side is used as a substrate rear face. And the substrate rear face 501 has the structure of reflecting the incident light from the substrate front face in alignment with an optical axis in front faces 502 other than the direction of an optical axis. Structure is made into the total reflection side which consists of a mirror plane as an example. Moreover, the front face 502 lies at right angles to the substrate front face 500.
[0019] When the perimeter of a monotonous micro lens is made into atmospheric air and the refractive index of a glass substrate is made into the larger real number n than 1, the include angle theta which a reflector 501 makes to the optical axis of a micro lens 101 is selected so that it may become the include angle which fills condition theta=COS -1 (1/n) which carries out total reflection of the incident light.
[0020] The optical contact which mounted this monotonous-with reflector micro lens in drawing 5 is shown. The optical contact consists of one substrate 400 with which two or more optical fibers 200 arranged by one dimension, the monotonous-with

reflector micro lens 104, and photo diode 300 and pre amplifier 301 were formed. Only the number with which photo diode 300 and pre amplifier 301 are equivalent to the number of a micro lens 101 is arranged by one dimension.
[0021] The monotonous-with reflector micro lens 104 turns a micro lens 101 to an optical fiber 200 side, and is arranged. The light-receiving side of photo diode 300 is established in the location where the light which carried out outgoing radiation from the field 502 of a monotonous micro lens converges. Moreover, photo diode 300 is connected to pre amplifier 301 by the bonding wire 408.
[0022] In the optical contact of such structure, it is condensed through a micro lens 101 and total reflection of the light L which carried out outgoing radiation from the optical fiber 200 is carried out in the reflector 501 established in the rear face, it can bend an include angle, it carries out outgoing radiation from the field 502 of the monotonous micro lens 104, and it carries out incidence to the light-receiving side of photo diode 300 established on the substrate 400. The output from this photo diode is sent to pre amplifier 301 through a bonding wire 408.
[0023] In this optical contact, it is quite short compared with the conventional optical contact shown in drawing 3 , and since the distance between photo diode and pre amplifier does not have curved wiring, there are also few inductance components, and it can expect high-speed operation.
[0024] Although the case where a micro lens 101 was turned to an optical fiber side was illustrated in the above optical contact, a lens 101 may be turned this and reversely at a photo diode side. Drawing 6 shows the optical contact which mounted the monotonous micro lens.
[0025] Next, the manufacture approach of the monotonous micro lens which makes a reflector 501 a mirror plane is explained with reference to drawing 7 and drawing 8 . The glass substrate 105 with which the micro lens 101 was formed is pasted up on the back up plate 110 with adhesives. A reflector is formed in the rear face of a glass substrate in this condition. This uses cutting techniques, such as slicing, for a substrate rear face, selects the include angle of suitable edge thickness and the edge of a blade, and is performed by producing the slot of the V type of a desired include angle at suitable spacing.
[0026] As shown in drawing 7 , specifically it is begun to delete a reflector for the grinding gear tooth 600 doubled with the include angle of the reflector 501 formed in a glass substrate 105. Under the present circumstances, it is possible to make a reflector into a mirror plane by selection of the field of a grinding gear tooth. Then, another grinding gear tooth separates the monotonous micro lens 104. That is, as shown in drawing 8 , cutting for separation of a monotonous micro lens is performed. Since light does not pass along the field of the cutting slot 700, a coarse field is sufficient, and since light passes, the field of the cutting slot 701 needs to be a mirror plane. The specification of a cutting gear tooth is chosen according to such a request. Usually, if it is going to perform mirror plane finishing, ****** will become soft and a dental life will become remarkably short. Therefore, the method of performing extent cutting which is coarse finishing and adding cutting for mirror plane finishing to the last is also possible.
[0027] It is desorbed from the separated monotonous micro lens 104 from the back up plate 110, and the monotonous micro lens of the structure of drawing 4 is obtained.
[0028] Although the above monotonous micro lens makes a reflector a mirror plane and carries out total reflection of the light, it can prepare and reflect a metal thin film on a mirror plane 501. In this case, unlike total reflection, there is no limit in an include angle theta. In addition, as a metal thin film, the metal thin film which has high reflection factors, such as aluminum, is used.
[0029] Now, according to the monotonous micro lens of this invention, the optical path length in a monotonous micro lens can change the optical path length, without affecting an optical property compared with the monotonous micro lens of the conventional parallel monotonous mold, since it is changeable by adjusting the amount of cutting on the rear face of a substrate.
[0030] Moreover, in the monotonous micro lens of structure which prepared the metal thin film in the substrate rear face, since positioning becomes possible in contact with other components about a substrate rear face at a real unit, positioning accuracy can be raised.
[0031] Although 301 was furthermore illustrated as pre amplifier with the optical contact of an example, this invention may be a drive circuit which impresses bias etc. not only to this but to photo diode.
[0032]
[Effect of the Invention] The monotonous micro lens which can change the optical path length is obtained without affecting an optical property according to the monotonous micro lens of this invention, as explained above.
[0033] Moreover, in the monotonous micro lens of the structure which prepared the metal thin film in the substrate rear face, and was made into the reflector, the positioning accuracy at the time of mounting can be raised.
[0034] In the optical contact which furthermore mounted the monotonous micro lens of this invention, high-speed operation becomes possible.

TECHNICAL FIELD

[Field of the Invention] This invention relates to a monotonous micro lens especially the monotonous micro lens which has a reflector, and its manufacture approach. Furthermore, it is related with the optical contact which mounted such a monotonous micro lens.

PRIOR ART

[Description of the Prior Art] A monotonous micro lens is a lens with which the microlens (micro lens) was embedded on the glass substrate front face. As shown in drawing 1 , such a monotonous micro lens forms the ion-exchange protective mask 102 which has opening 103 on a glass substrate 100, and is immersed into a solution. A micro lens 101 is formed by exchanging the ion B inside glass (for example, K, Na), and the ion A (for example, Tl) contained in an external solution from opening of a protective mask. The function as a lens is achieved because a refractive index rises because Ion A goes into the interior of glass, and the diffusion becomes semi-sphere-like. That is, a micro lens is a lens with the refractive-index inclination which changes gently-sloping towards the direction which has an optical axis in the direction of a substrate side normal, and intersects perpendicularly with the direction of an optical axis, and an optical axis.
[0003] Since the ion-exchange protective mask 102 is formed by the phot lithography method, many lenses can be made to arrange two-dimensional. This situation is shown in drawing 2 . Many micro lenses 101 are arranged on the glass substrate 100.
[0004] An example of an optical contact which used the monotonous micro lens for drawing 3 is shown. This optical contact is equipment from which two or more micro lenses condense to the photo diode 300 arranged by one dimension, and change into an electrical signal the light from two or more optical fibers 200 arranged by one dimension by the monotonous micro lens 100

arranged by one dimension. The photo diode train is established on the ceramics 400 of a rectangular parallelepiped, and pre amplifier 301 is formed on the ceramics 401 of the rectangular parallelepiped of another object.
[0005] In this optical contact, an optical fiber 200, a micro lens 101, and photo diode 300 are arranged on one optical axis. Therefore, the electrical installation of photo diode 300 and pre amplifier 301 is formed as follows. The output from photo diode 300 passes along a bonding wire 405, and is connected to the wiring 403 on ceramics 400. Wiring 403 is connected to the wiring 404 on the substrate 401 in which pre amplifier 301 appears through a bonding wire 406 again. The connection between wiring 404 and pre amplifier 301 is made by the bonding wire 407.
[0006] In the above optical contacts of a configuration, it is condensed through a lens 101 and incidence of the light which came out of the optical fiber 200 is carried out to photo diode 300. Photo diode 300 changes into an electrical signal the light which carried out incidence. An electrical signal is sent to pre amplifier 301 through a wire 405, wiring 403, a wire 406, wiring 404, and a wire 407.

EFFECT OF THE INVENTION

[Effect of the Invention] The monotonous micro lens which can change the optical path length is obtained without affecting an optical property according to the monotonous micro lens of this invention, as explained above.
[0033] Moreover, in the monotonous micro lens of the structure which prepared the metal thin film in the substrate rear face, and was made into the reflector, the positioning accuracy at the time of mounting can be raised.
[0034] In the optical contact which furthermore mounted the monotonous micro lens of this invention, high-speed operation becomes possible.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In the conventional optical contact shown in drawing 3 , as the wiring 403 in pre amplifier 301 from photo diode 300 showed drawing 3 , in order to bend at a right angle, an inductance component occurs. For this reason, there was a problem that a high-speed property deteriorated.
[0008] Moreover, in order to change the optical path length in a monotonous micro lens, it is necessary to change the thickness of a monotonous micro lens but, and when thickness is changed, there is a problem of affecting an optical property.
[0009] Moreover, since a monotonous micro lens is the plate of one sheet, and it is difficult to make other components contact on the occasion of mounting, it has the problem that positioning is difficult.
[0010] The purpose of this invention is to offer the monotonous micro lens which solved the above problems.
[0011] Other purposes of this invention are to offer the manufacture approach of the above-mentioned monotonous micro lens.
[0012] The purpose of further others of this invention is to offer the optical contact which used the above-mentioned monotonous micro lens.

MEANS

[Means for Solving the Problem] In the monotonous micro lens which really formed the lens with the refractive-index inclination which changes gently-sloping towards the direction which has an optical axis in this direction of a substrate side normal, and intersects perpendicularly with the direction of an optical axis, and an optical axis in the transparence substrate according to this invention If a substrate front face and the field of the opposite side are used as a substrate rear face for the field where the lens was created, it will be characterized by a substrate rear face having the structure of reflecting the incident light from the substrate front face in alignment with an optical axis in the direction of [other than the direction of an optical axis].
[0014] The include angle theta was selected so that a substrate rear face might be made into the mirror plane which has the inclination of an include angle theta to an optical axis and might carry out total reflection as reflective structure in a mirror plane.
[0015] Or the metal thin film which has a high reflection factor may be prepared in a substrate rear face as reflective structure again.
[0016] Such a monotonous micro lens is manufactured from said back up plate according to the process from which it is desorbed in the process which really forms a gradient index lens in the front face of the transparence substrate which has an parallel flat surface according to an ionic diffusion, the process which pastes up the back up plate on a substrate front face with adhesives, the process which carries out cutting of the slot on the V type to the rear face of a transparence substrate at suitable spacing, the process which carries out cutting of the slot of U mold so that it may separate into the monotonous micro lens containing one side of V mold groove, and the monotonous micro lens which be separated.
[0017] Moreover, the optical contact of this invention is equipped with the amplifier connected to the optical fiber, the monotonous micro lens which carries out incidence, is reflected with the substrate rear face and carries out outgoing radiation of the outgoing radiation light from an optical fiber from a substrate front face, the optical/electrical converter which was formed on the same substrate, and which receives the outgoing radiation light from said monotonous micro lens, and the optical/electrical converter by the bonding wire.
[0018]
[Embodiment of the Invention] The perspective view of the monotonous micro lens of this invention and a sectional view are shown in drawing 4 (a) and (b). This monotonous micro lens 104 makes this substrate rear face 501 the slant face which makes the inclination of theta to the optical axis of a micro lens 101, when the field where the micro lens 101 was created in the transparence substrate 100, for example, a glass substrate, is used as the substrate front face 500 and the field of that opposite side is used as a substrate rear face. And the substrate rear face 501 has the structure of reflecting the incident light from the substrate front face in alignment with an optical axis in front faces 502 other than the direction of an optical axis. Structure is made into the total reflection side which consists of a mirror plane as an example. Moreover, the front face 502 lies at right angles to the substrate front face 500.
[0019] When the perimeter of a monotonous micro lens is made into atmospheric air and the refractive index of a glass substrate is made into the larger real number n than 1, the include angle theta which a reflector 501 makes to the optical axis of a micro lens 101 is selected so that it may become the include angle which fills condition theta=COS -1 (1/n) which carries out total

reflection of the incident light.
[0020] The optical contact which mounted this monotonous-with reflector micro lens in drawing 5 is shown. The optical contact consists of one substrate 400 with which two or more optical fibers 200 arranged by one dimension, the monotonous-with reflector micro lens 104, and photo diode 300 and pre amplifier 301 were formed. Only the number with which photo diode 300 and pre amplifier 301 are equivalent to the number of a micro lens 101 is arranged by one dimension.
[0021] The monotonous-with reflector micro lens 104 turns a micro lens 101 to an optical fiber 200 side, and is arranged. The light-receiving side of photo diode 300 is established in the location where the light which carried out outgoing radiation from the field 502 of a monotonous micro lens converges. Moreover, photo diode 300 is connected to pre amplifier 301 by the bonding wire 408.
[0022] In the optical contact of such structure, it is condensed through a micro lens 101 and total reflection of the light L which carried out outgoing radiation from the optical fiber 200 is carried out in the reflector 501 established in the rear face, it can bend an include angle, it carries out outgoing radiation from the field 502 of the monotonous micro lens 104, and it carries out incidence to the light-receiving side of photo diode 300 established on the substrate 400. The output from this photo diode is sent to pre amplifier 301 through a bonding wire 408.
[0023] In this optical contact, it is quite short compared with the conventional optical contact shown in drawing 3 , and since the distance between photo diode and pre amplifier does not have curved wiring, there are also few inductance components, and it can expect high-speed operation.
[0024] Although the case where a micro lens 101 was turned to an optical fiber side was illustrated in the above optical contact, a lens 101 may be turned this and reversely at a photo diode side. Drawing 6 shows the optical contact which mounted the monotonous micro lens.
[0025] Next, the manufacture approach of the monotonous micro lens which makes a reflector 501 a mirror plane is explained with reference to drawing 7 and drawing 8 . The glass substrate 105 with which the micro lens 101 was formed is pasted up on the back up plate 110 with adhesives. A reflector is formed in the rear face of a glass substrate in this condition. This uses cutting techniques, such as slicing, for a substrate rear face, selects the include angle of suitable edge thickness and the edge of a blade, and is performed by producing the slot of the V type of a desired include angle at suitable spacing.
[0026] As shown in drawing 7 , specifically it is begun to delete a reflector for the grinding gear tooth 600 doubled with the include angle of the reflector 501 formed in a glass substrate 105. Under the present circumstances, it is possible to make a reflector into a mirror plane by selection of the field of a grinding gear tooth. Then, another grinding gear tooth separates the monotonous micro lens 104. That is, as shown in drawing 8 , cutting for separation of a monotonous micro lens is performed. Since light does not pass along the field of the cutting slot 700, a coarse field is sufficient, and since light passes, the field of the cutting slot 701 needs to be a mirror plane. The specification of a cutting gear tooth is chosen according to such a request. Usually, if it is going to perform mirror plane finishing, ****** will become soft and a dental life will become remarkably short. Therefore, the method of performing extent cutting which is coarse finishing and adding cutting for mirror plane finishing to the last is also possible.
[0027] It is desorbed from the separated monotonous micro lens 104 from the back up plate 110, and the monotonous micro lens of the structure of drawing 4 is obtained.
[0028] Although the above monotonous micro lens makes a reflector a mirror plane and carries out total reflection of the light, it can prepare and reflect a metal thin film on a mirror plane 501. In this case, unlike total reflection, there is no limit in an include angle theta. In addition, as a metal thin film, the metal thin film which has high reflection factors, such as aluminum, is used.
[0029] Now, according to the monotonous micro lens of this invention, the optical path length in a monotonous micro lens can change the optical path length, without affecting an optical property compared with the monotonous micro lens of the conventional parallel monotonous mold, since it is changeable by adjusting the amount of cutting on the rear face of a substrate.
[0030] Moreover, in the monotonous micro lens of structure which prepared the metal thin film in the substrate rear face, since positioning becomes possible in contact with other components about a substrate rear face at a real unit, positioning accuracy can be raised.
[0031] Although 301 was furthermore illustrated as pre amplifier with the optical contact of an example, this invention may be a drive circuit which impresses bias etc. not only to this but to photo diode.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the manufacturing method of the conventional monotonous micro lens.
[Drawing 2] It is drawing showing the structure of the conventional monotonous micro lens.
[Drawing 3] It is drawing showing the conventional optical contact.
[Drawing 4] It is drawing showing the monotonous-with reflector micro lens concerning this invention.
[Drawing 5] It is drawing showing the optical contact which mounted the monotonous micro lens of the structure of drawing 4 .
[Drawing 6] It is drawing showing the optical contact which changed and mounted arrangement of a monotonous micro lens.
[Drawing 7] It is drawing for explaining the manufacture approach of the monotonous-with reflector micro lens concerning this invention.
[Drawing 8] It is drawing for explaining the manufacture approach of the monotonous-with reflector micro lens concerning this invention.
[Description of Notations]
100,105 Glass substrate
101 Micro Lens
104 Monotonous-with Reflector Micro Lens
110 Back Up Plate
200 Optical Fiber
300 Photo Diode
301 Pre Amplifier
400,401 Mounting substrate
405,406,408 Bonding wire
500 Substrate Front Face
501 Substrate Rear Face
600 Cutting Gear Tooth

700,701 Cutting slot
A, B Ion exchanged
L Hikaru Idei from a fiber

DRAWINGS

[Drawing 1]

[Drawing 2]

[Drawing 3]

[Drawing 4]

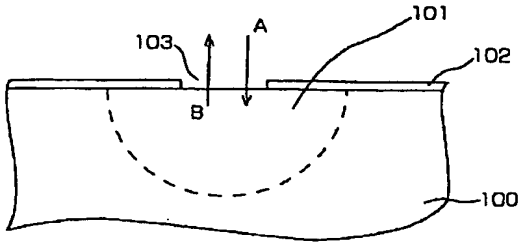
[Drawing 5]

[Drawing 6]

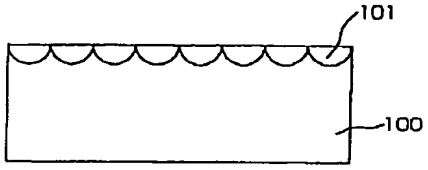
[Drawing 7]

[Drawing 8]

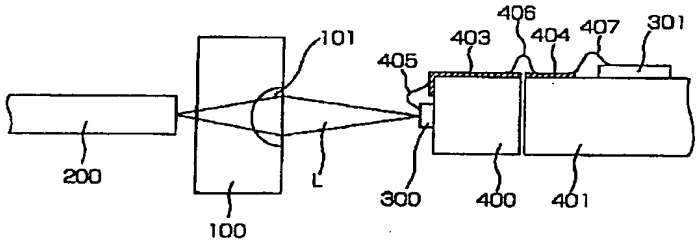
〈drawing 1〉



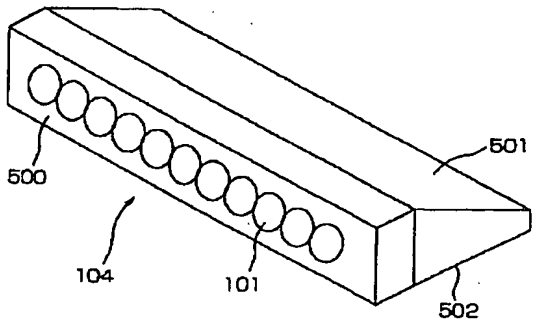
〈drawing 2〉



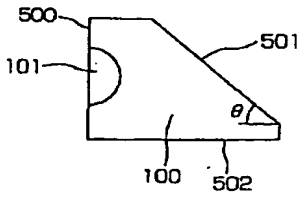
〈drawing 3〉



〈drawing 4〉

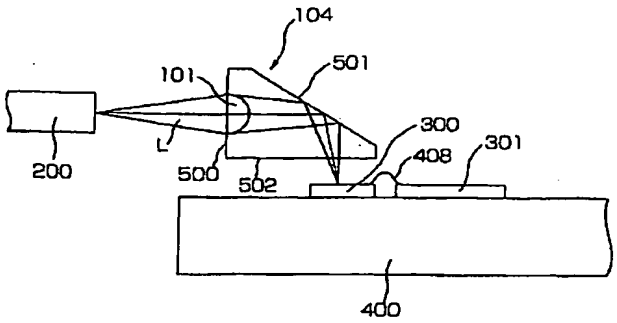


(a)

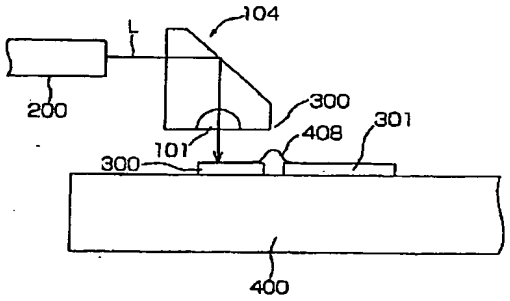


(b)

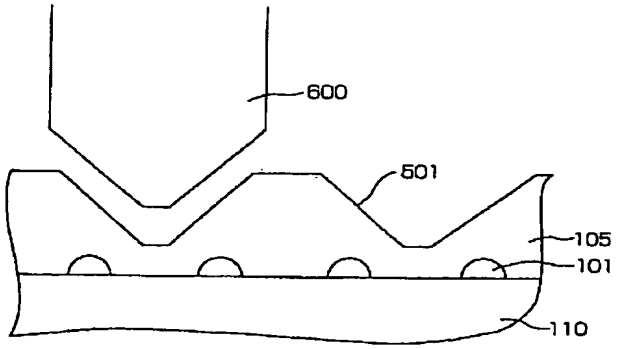
<drawing 5>



<drawing 6>



<drawing 7>



<drawing 8>